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February 14, 2001

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

<u>VIA HAND DELIVERY</u>

Magalie Roman Salas, Secretary
Federal Communications Commission
The Portals, 445 12th Street, S.W., Room TW-B204
Counter TW-A325
Washington, D.C. 20554

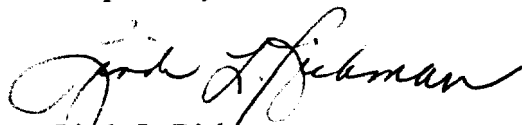Re: Written *Ex Parte* Communication in
<u>ET Docket No. 98-206, RM-9147, RM-9245, DA 99-494</u>

Dear Ms. Salas:

Pursuant to 47 C.F.R. Sec. 1.1206, Northpoint Technology, Ltd. and Broadwave USA, hereby provide the attached written *ex parte* submission in the above-referenced proceeding.

Respectfully submitted,

Linda L. Rickman
Vice President – Washington Operations
Northpoint Technology, Ltd.
Broadwave USA

Attachment

cc: Julius Knapp
       Thomas Stanley
       Thomas Derenge
       Rebecca Dorch
       Michael Marcus
       Mark Oakey
       Paul Locke

No. of Copies rec'd 0+12
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February 13, 2001

The MITRE Corporation
Attention: Jim Chadwick
Mail Stop W300
1820 Dolley Madison Blvd.
McLean, VA 22102

Dear Mr. Chadwick:

Northpoint/Broadwave USA has reviewed the input provided by the DBS industry in response to your first set of questions, and would like to offer information relevant to your efforts that will correct a few factual errors contained therein.

In answering the question on antenna variability (Question 2), DBS says it uses a "customary" 0.5 dB for antenna pointing errors for the purpose of developing DBS system link budgets. We note that most DBS installations are performed by professional installers, and not by consumers. However, whether installed by a professional or not, it should be clear that the antenna can be pointed to within 0.2 dB with only the rudimentary meter supplied in the set top box.[1] Thus, the 'customary' 0.5 dB error probably exceeds by a factor of 2 or 3 the error likely to be found in the real world.

With respect to the DBS answer on co-channel protection ratios (Question 7), DBS states that it does not have any specific co-channel protection ratio requirements. However, they offer as a "point of reference, an aggregate co-channel protection ratio of 28 dB…" used by the ITU as a planning parameter to set up the Region 2 BSS plan; intended for analogue satellite interference into analogue transmissions. We would provide a different 'point of reference,' the protection ratio of 21 dB, recently adopted by the World Radiocommunication Conference 2000.[2] This point of reference is for the evaluation of digital interference into digital BSS systems in Regions 1&3.

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[1] See the attachment to their response were DBS provides a table showing an SS count meter accurate to 0.2 dB.

[2] A copy of Section 3.4, Annex 5, Appendix S30 from the ITU Radio Regulations from the Final Acts of WRC-2000 is attached.

In its response to the MITRE question regarding the "Pass/Fail criteria" (Question 10), DBS states that "quasi-error free operation" is the criterion used in recent ITU-R proceedings to arrive at protection of the BSS from "all interference sources."[3] This too is in error. The ITU-R sharing criteria used the freeze frame point to develop allowable interference levels into DBS from NGSO FSS systems.[4]

DBS further states that the values chosen for the operational threshold are set for "worst-case transponder characteristics and worst case demodulator performance. Performance through randomly selected off-the-shelf receivers and through an average satellite transponder may be better." In other words, DBS is relying on extremely conservative assumptions that might never be found in the real world. When considering that Northpoint interference will not even be measurable at more than 99.5% of DBS customer locations, it becomes clear that such extreme worst case assumptions can not be appropriately applied to such a small population; and that more realistic assumptions are appropriate. This is why Northpoint suggests the loss of synchronization threshold be used to determine an outage.

With respect to use of DBS transmitter for controlled laboratory testing (Question 11), DBS "strongly recommends" using actual satellite signals for testing. We must observe that such a signal is not under control of MITRE but of one of the interested parties. Thus, the independence of the test may be called into question. If MITRE has no control of the signal generation and transmission, it may not know if the signal is corrupted in some fashion. This may occur through transmission equipment degradation or failure, unaccounted for noise or other interfering sources.

Finally, we would offer a few observations on the 'Attachment A' provided by DBS. This attachment discusses the signal strength meter in the customers' set top box. DBS asserts: any "receiver can be calibrated to provide very accurate C/N… values from the deflection of the SS meter." They go on to state that its "accuracy and dependability [can provide a means to] constantly monitor the condition of the satellite payload," and that "through calibration, extremely accurate results can be obtained."

While DBS does not state the accuracy that it believes can be achieved, it is obvious that a consumer grade set top box cannot substitute for laboratory grade equipment, nor do we believe it can provide "very accurate" measurements of C/N. We have used this meter in evaluating the performance of DBS, but find its reliability to be such that it can best be used for qualitative evaluations.

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[3]   DBS Response, (emphasis added) page 4. The operational threshold is typically chosen to be 1.5 dB above the C/N freeze frame point.

[4]   See ITU Recommendation BO.1444, Recommends 1.2 and Notes 1 and 2, document attached. It is true that the ITU efforts erroneously used the "operational threshold" for availability calculations, but the freeze frame point is the point at which the MPEG decoder ceases to provide full pictures, and is the threshold used in the development of one of the sharing criterion. See also the Northpoint Technology response to question 10, Jan 31, 2001.

For proof of this, one need only examine the test results submitted by DBS in the FCC proceeding 98-206. In its "Report of Interference Impact on DBS Systems," (July 25, 2000) DBS estimates its received satellite C/N values from the signal strength meter. However, these estimated C/N values in no case agree with the satellite link budgets that DBS presents in the same document, differing by 1.3 to 2.1 dB.[5] DBS offers no explanation for this discrepancy. DBS makes the same error in a later report,[6] where the DBS 'measured' C/N was 11.7 dB and the DBS 'predicted' C/N was 12.7 dB.[7] We assert that if the signal strength meter were a 'very accurate' predictor of C/N, then DBS should have been able reconcile it to its own link budgets.

As another example of the inability of this device to provide "very accurate" measurements, in about 40 percent of the Washington D.C. tests, *the signal strength meter actually increased when we turned on the Northpoint transmitter.*[8] We also demonstrated that the SS meter has a temporal variance of 2-3 counts in the Washington D.C. tests.[9]

Further, we have found that the SS meter is prone to hysteresis, and thus "very accurate" measurements are impractical, if not impossible. Thus, while it may be used to tune the satellite signal to within 0.2 dB of a "peak", it cannot be used to determine what the "peak" C/N level is, nor can it be used to accurately quantify performance levels with reliability.

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[5] See page 7 of "Northpoint's Evaluation and Analysis of DBS-Terrestrial Compatibility Testing," July 31, 2000.

[6] "Conclusions to Date Regarding Harmful Interference From a Proposed Northpoint Technology Terrestrial System Operating in the DBS Downlink Band, 12.2 – 12.7 GHz," dated March 17, 2000.

[7] See the detailed discussion in "Response to DirecTV", March 17, 2000 submission of Northpoint Technology, pages 10-13.

[8] See page 13 of "Northpoint-DBS Compatibility Tests," October 1999. According to DBS, such an increase would mean that the satellite signal quality improved in the presence of Northpoint interference.

[9] See page 8 of "Northpoint-DBS Compatibility Tests," October 1999.

In closing, while this discussion may already be obvious to the experienced
MITRE engineer, we felt an obligation to bring these facts to your attention. If there are
any questions or comments, please contact me at your convenience

Sincerely,

Bob Combs
Director, System Development

cc: FCC - Magalie Roman Salas, Secretary

Atch: 1. ITU-R Recommendation BO.1444 (w/o annexes)
       2. Excerpt from Final Acts of WRC-2000
       3. Copy of "Answers from the DBS Operators to Questions Posed by the MITRE
          Corporation."

RECOMMENDATION ITU-R BO.1444

PROTECTION OF THE BSS IN THE 12 GHz BAND AND ASSOCIATED FEEDER LINKS IN THE 17 GHz BAND FROM INTERFERENCE CAUSED BY NON-GSO FSS SYSTEMS

(Questions ITU-R 85/11 and ITU-R 223/11)

(2000)

The ITU Radiocommunication Assembly,

considering

a)   that the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are allocated to the BSS;

b)   that the BSS in the above bands is subject to the Plans in RR Appendix S30;

c)   that the bands 17.3-17.8 GHz in Region 2 and 17.3-18.1 GHz in Regions 1 and 3 are allocated to the feeder links of the BSS;

d)   that the feeder links of the BSS in the above bands are subject to the Plans in RR Appendix S30A;

e)   that the band 12.5-12.75 GHz in Region 3 is also allocated to the BSS;

f)   that the band 17.8-18.1 GHz in Region 2 is also allocated to the feeder links of the BSS;

g)   that WRC-97 allocated the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2, 11.7-12.2 GHz and 12.5-12.75 GHz in Region 3 to the non-GSO FSS (space-to-Earth) and 17.3-17.8 GHz in Regions 1 and 3 and 17.8-18.1 GHz in Regions 1, 2 and 3 to the non-GSO FSS (Earth-to-space) subject to the provisions of Resolution 538 (WRC-97);

h)   that emissions from the stations of non-GSO satellite systems may result in interference to BSS networks and associated feeder links when these networks operate in the same frequency bands;

j)   that RR No. S22.2 states that non-GSO satellite systems shall not cause unacceptable interference to GSO satellite systems in the FSS and BSS operating in accordance with the RR;

k)   that WRC-97 adopted provisional equivalent power flux-density (epfd) limits to quantify the level of unacceptable non-GSO interference and requested ITU-R to review these limits in order to ensure appropriate protection of the Plans and their future modifications;

l)   that there exist criteria to protect the BSS networks and associated feeder links from other such networks operating in the same regional plan or in another Regional Plan (RR Appendix S30, Annex 1 and RR Appendix S30A, Annex 1);

m)   that there exist criteria to protect the BSS networks from FSS networks in another Region (RR Appendix S30, Annex 4) and to protect the associated feeder links from FSS networks in the same or in another Region (RR Appendix S30A, Annex 4);

n)   that there is a need to define criteria to protect a network in the BSS and associated feeder links from interference caused by non-GSO FSS systems;

o)   that the harmonious development of non-GSO FSS systems and GSO BSS and associated feeder-link networks requires that the conditions under which the sharing would be feasible should be identified as soon as possible;

p)   that the integrity of the Plans in RR Appendices S30 and S30A and their future modifications is to be ensured,

considering further

a)   that the BSS and associated feeder-link system designer should be able to control the overall performance of a network and to provide a quality of service that meets its C/N performance objectives;

b)   that to allow an operator to exercise control over the quality of service, there needs to be a limit on the aggregate interference a network must be able to tolerate from emissions of all other networks;

c)   that in order to facilitate the introduction of non-GSO FSS systems in accordance with the provisions of RR Article S22, it is necessary to establish sharing criteria that are applicable to individual non-GSO FSS systems;

d)   that in frequency bands above 10 GHz where very high propagation attenuation may occur for short periods of time, it may be desirable for GSO and non-GSO systems to make use of some form of fade compensation;

e)   that in interference situations involving non-GSO systems, BSS and associated feeder-link networks are potentially exposed to high levels of interference for short periods of time which could affect the performance or availability of these networks;

f)   that short-term interference events may cause a loss of video picture continuity or other unstable conditions in digital BSS transmissions which may cause a degradation or loss of service for periods longer than interference events;

g)   that in interference situations involving non-GSO systems, BSS networks and associated feeder links are potentially exposed to low levels of interference for long periods of time which could degrade the performance or availability of those networks;

h)   that the performance and availability of an operating GSO-BSS system and its associated feeder links are degraded by external interfering noise contributions which may be steady state or of a statistical nature;

j)   that such degradations may be due to propagation anomalies, other GSO networks and other systems including non-GSO FSS systems that share the same band;

k)   that emissions from the earth stations as well as from the space station of a satellite network (GSO BSS and associated feeder links or non-GSO FSS) in those bands may result in interference to another such network when both networks operate in the same bands;

l)   that a methodology is required to allow an accurate assessment of the time varying impact of epfd and apfd limits for non-GSO FSS networks on the performance of GSO BSS networks and associated feeder links;

m)   that the methodology would facilitate the determination of appropriate epfd and apfd limits that would provide suitable protection of the GSO BSS and associated feeder links,

recommends

1   that for a GSO BSS network in the 12 GHz band and its associated feeder links in the 17 GHz band, the aggregate inter-network interference caused by the earth and space

station emissions of all non-GSO FSS satellite networks operating in the same frequency band, should:

1.1   be responsible for at most 10% of the time allowance(s) for unavailability of the given C/N value(s) as specified in the performance objectives of the desired network, where N is the total noise level in the noise bandwidth associated with the wanted carrier including all other non-time-varying sources of interference;

1.2   not lead to a loss of video picture continuity (see Note 1) in the desired digital GSO BSS and associated feeder-link network under clear-sky conditions (see Note 2);

2   that epfd limits as defined in RR Article S22 and applicable respectively to non-GSO FSS systems to be operated in the 12 GHz bands shared with BSS and in the 17 GHz frequency bands shared with BSS feeder links be derived and specified in such a way:

2.1   that they satisfy the criteria in *recommends* 1.1 and 1.2 when applied to a set of representative GSO BSS and associated feeder-link system characteristics, as provided in Annex 1;

2.2   that the apportionment of the aggregate interference allowance specified in *recommends* 1.1 and 1.2 to derive single entry limits be based on the effective number of non-GSO FSS systems that are anticipated to share the same frequency bands;

2.3   that these limits are specified by continuous curves of cumulative density function for a range of representative GSO receiving antenna sizes (see Note 3);

3   that the methodologies given in Annexes 2 and 3, in connection with an appropriate assumed number of non-GSO FSS systems, be applied for assessing the impact on the GSO BSS in the 12 GHz band and the associated feeder links in the 17 GHz band of epfd and apfd limits applicable to the non-GSO FSS (see Note 4);

4   that the methodology described in Annex 4 be used to assess if the provisions of *recommends* 1.2 are satisfied;

5   that the following Notes form part of the Recommendation.

NOTE 1 – A loss of MPEG video picture continuity occurs when the BER of the demodulated MPEG video bit stream is sufficiently high to cause the associated video MPEG decoder to cease to provide one or more pictures. This condition typically results in the initiation of error concealment techniques by the video decoder, such as the presentation of the last available MPEG picture (freeze frame), presentation of an all black picture, or other techniques.

NOTE 2 – Administrations were requested to indicate the difference (dB) between the $C/(N + I)$ required at operating threshold, which is found on line 13 of the database spreadsheet, and the loss of video picture continuity performance point for each link. If this information is not provided by the responsible administration, a default value of 1.5 dB will be assumed.

NOTE 3 – Further study is required to ensure that, to the extent possible, these limits are consistent with the protection levels currently afforded to the Plans in RR Appendices S30 and S30A and their future modifications.

NOTE 4 – Calculations were carried out to establish the consistency of the results between the two methodologies. It was found that the two methods gave consistent results.

However, it was found that in some cases there are significant differences in the unavailability calculated by the two programs. Detailed studies that were performed demonstrated that differences between the two programs were encountered when analysing links using large earth stations antenna sizes (i.e. 120 cm and larger). The reason for this difference may be related to the link degradation resulting from the epfd limit for 100% of the time being close to the available degradation in the link.

Administrations using these software packages should pay special attention to this finding.

ANNEX 1

BSS system characteristics

The database which is contained in this annex consists of characteristics of operational and planned GSO BSS networks and the associated feeder links provided in response to Circular Letters CR-92 and CR-116 for the purpose of arriving at recommended epfd masks which will help in sharing studies between GSO BSS and non-GSO FSS systems.

This database in Excel format is available in electronic form at the ITU Website:
http://www.itu.int//itudoc/itu-r/sg11/docs/sg11/1998-00/contrib/138e2.html

APS30-45

MOD

3.4 Protection ratio between television signals

For developing the original 1977 broadcasting-satellite service Plan for Regions 1 and 3, the following protection ratios were used[27, 28]:

- 31 dB for co-channel signals;

- 15 dB for adjacent channel signals.

For revising this Plan at WRC-97, the following aggregate downlink protection ratios were specified in Recommendation ITU-R BO.1297 for the purpose of calculating downlink equivalent protection margins[28, 28bis, 28ter]:

- 24 dB for co-channel signals;

- 16 dB for adjacent channel signals.

In revising the Regions 1 and 3 Plan at WRC-97, the following aggregate overall protection ratio values were used (as specified in Recommendation 521 (WRC-95)) for calculating the overall co-channel and adjacent-channel protection margins as defined in § 1.8 and 1.9 of this Annex:

- 23 dB for co-channel signals;

- 15 dB for adjacent channel signals.

Recommendation 521 (WRC-95) also specified that for the revision of the Regions 1 and 3 Plan, no overall co-channel single entry C/I should be lower than 28 dB.

However, for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997, the overall equivalent protection margins were calculated using a co-channel overall protection ratio of 30 dB and lower and upper overall adjacent channel protection ratios of 14 dB[29].

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[27] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

[28] The equivalent protection margin M is given in dB by the formula

$$M = -10 \log (10^{-M_1/10} + 10^{-M_2/10} + 10^{-M_3/10})$$

where M_1 is the value in dB of the protection margin for the same channel. This is defined in the following expression where the powers are evaluated at the receiver input:

$$\frac{\text{wanted power}}{\text{sum of the co-channel interfering powers}} \text{ (dB)} - \text{co-channel protection ratio (dB)}$$

M_2 and M_3 are the values in dB of the upper and lower adjacent-channel protection margins respectively.

The definition of the adjacent-channel protection margin is similar to that for the co-channel case except that the adjacent-channel protection ratio and the sum of the interfering powers due to emissions in the adjacent channel are considered.

[28bis] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau between 27 October 1997 and 12 May 2000.

[28ter] These protection ratio values were used for protection of digital and analogue assignments from analogue emissions.

[29] The overall protection margin calculation method used is based on the first formula in § 1.12 of Annex 3 to Appendix S30A.

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WRC-2000 adopted, for the protection of digital assignments from digital emissions, the following protection ratio values to be applied for calculation of downlink equivalent protection margins of the WRC-2000 Regions 1 and 3 BSS Plan:

–   21 dB for co-channel signals;

–   16 dB for adjacent channel signals.

During planning at WRC-2000, these values were used for all assignments of the Regions 1 and 3 BSS Plan and List except those for which WRC-2000 adopted different values used in the planning process*.

Revision of the Regions 1 and 3 Plan at WRC-97 and planning at WRC-2000 were generally based on a set of reference parameters such as the average e.i.r.p., the reference earth station receiving antenna, all test points placed within the –3 dB contour, a bandwidth of 27 MHz and the predetermined value of C/N. The Regions 1 and 3 Plan as established by WRC-2000 is generally based on the use of digital modulation.

Protection masks and associated calculation methods for interference into broadcast satellite systems involving digital emissions are given in Recommendation ITU-R BO.1293-1.

MOD

3.8   Necessary bandwidth

WARC-77 Regions 1 and 3 BSS Plan and the WRC-97 revision of the Regions 1 and 3 BSS Plan used the following:

–   625-line systems in Regions 1 and 3: 27 MHz;

–   525-line systems in Region 3: 27 MHz.

The planning at WRC-2000 was generally based on a necessary bandwidth of 27 MHz.

In Region 2, the Plan is based on a channel bandwidth of 24 MHz[34], but different bandwidths may be implemented in accordance with the provisions of this Appendix, provided that applicable ITU-R Recommendations are available. In the absence of such Recommendations, the Bureau will use the worst-case approach.

If different bandwidths and/or channel spacing are submitted, they will be treated in accordance with applicable ITU-R Recommendations for protection masks when available. In the absence of such Recommendations, the Bureau will use the worst-case approach.

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*   For analogue assignments, the protection ratios adopted by WRC-97 were used (24 dB co-channel and 16 dB adjacent channel).

[34]   For France, Denmark and some of the United Kingdom requirements which use 625-line standards with greater video bandwidth, the channels shown in the Plan have a necessary bandwidth of 27 MHz. This is indicated by an appropriate symbol in the Plan.

January 31, 2001

The MITRE Corporation
Attention: Jim Chadwick, Mail Stop W300
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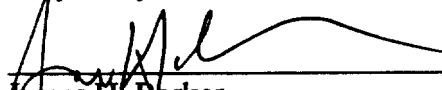McLean, VA 22102

Dear Mr. Chadwick:

Enclosed please find answers to questions posed by the MITRE Corporation to the DBS operators, DIRECTV, Inc. ("DIRECTV"), and EchoStar Satellite Corporation ("EchoStar").

As indicated to the FCC last week, DIRECTV and EchoStar believe that it would be extremely useful for MITRE representatives to meet as soon as possible with technical representatives of the DBS operators for approximately two hours to discuss the technical information provided. DIRECTV and EchoStar have no objection to a similar meeting being held by MITRE with Northpoint and other terrestrial system proponents.
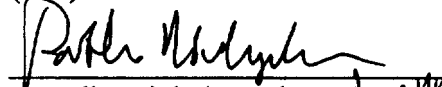
The DBS operators also reiterate their request that all parties be permitted to review MITRE's proposed test plan (and whether it will include any form of field testing), and ask that the parties be privy to the testing process and methodology. The DBS operators believe that such transparency is crucial to a fair process for all sides involved.

Please contact either of the undersigned should you have any questions.

Very Truly Yours,

James H. Barker
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ANSWERS FROM THE DBS OPERATORS
TO QUESTIONS POSED BY THE MITRE CORPORATION

1. *What margin do you operate with and what availability do you design to?*

Link margins vary from city to city, and are dependent on rain zone, satellite EIRP, etc. Margins range from only a few dB to 7 or 8 dB. Link budgets for DIRECTV and EchoStar satellites can be found in the joint DIRECTV and EchoStar filing on July 25, 2000, "Report of Interference Impact on DBS Systems from Northpoint Transmitter Operating at Oxon Hill, MD," which has been supplied to MITRE.

Regarding availability, it is important to note at the outset that DBS providers have been moving toward higher availabilities with the buildout of digital satellite transmission systems, and continue to do so. This point was discussed in the joint "Rebuttal to Northpoint's Evaluation and Analysis of DBS-Terrestrial Compatibility Testing at Oxon Hill Maryland," filed by DIRECTV and EchoStar on September 20, 2000, at 2-3, as well as in DIRECTV's "Further Response to Northpoint Ex Parte Filings," at 6-10, also filed on September 20, 2000. Thus, for example, the availability planning parameter 99.7% as stated in the original analog FM-based BSS Plan is not suitable for use with digital systems because of the steep bit error rate characteristic of these digital systems. In order to have roughly the same quality viewing experience between analog FM and digital systems – *i.e.*, to roughly match the time over which a picture is viewable, digital systems must have threshold availability values much higher than an annual average of 99.7%.

That is why satellite communications design engineers around the world are striving to build and preserve high availability values for digital links. As shown in the DIRECTV "Further Response" submission cited, a typical link shown in newly-adopted International Telecommunications Union ("ITU") BSS planning parameters for Regions 1 and 3 has an annual availability value of 99.998%.

Examples of current availability performance, which varies across the coverage area (but again, which DBS operators are striving to improve), can be seen both in the DBS link described in Appendix A of the January 27, 2000, DIRECTV report "Conclusions to Date Regarding Harmful Interference From a Proposed Northpoint Technology Terrestrial System Operating in the DBS Downlink Band, 12.2-12.7 GHz," and in Appendix B to the July 25, 2000, DIRECTV and EchoStar joint report on the Oxon Hill testing. These documents provide link budgets of DIRECTV service to Washington, DC.

2. *What variability do you expect in DBS antenna installations? (antenna azimuth, cable loss, etc.)*

For purposes of developing DBS system link budgets, it has been customary to use a loss of 0.5 dB for antenna pointing errors. This number assumes that a reasonable amount of care and effort has been applied to obtaining a good antenna mount and iterative antenna peaking to maximize the received signal. The iterative process involves peaking for

1

maximum signal in azimuth, tightening the antenna down in this plane, then peaking for elevation. It is recommended that this process be performed 2-3 times to assure that the highest possible signal reception has been achieved.

3. *What rain model do you use in your calculations?*

ITU rain model 618-5 has been used for all link budgets submitted in FCC filings for the last three years for both DIRECTV and EchoStar.

4. *Please provide a copy of your analysis showing why you think interference from MVDDS systems will be a problem. If it is more convenient, point us to the appropriate comments you have provided on the FCC 98-206 and 00-408 documents.*

Please see the filings containing analysis and test results of proposed Northpoint Technology system interference into DBS systems that have were provided in response to Question 9.

5. *Which situations do you believe will have the most potential for interference? Which cities, which DBS satellites, etc.?*

Situations that have the most potential for interference are described in detail in DIRECTV's filing of January 27, 2000 referenced in the answer to Question 4 above, section 2.1.4.1, "Predicted Interference Geometries." Basically, the most sensitive geometry is where the interference source intersects one of two spillover sidelobes of the DBS receive antenna, just off the back edge of the dish.

All U.S. communities have tremendous potential for interference with DBS operations depending, among other things, upon how a terrestrial system would be configured and deployed for mass market consumer operations, the density and location of the transmitters, etc. Cities that would be the most sensitive to terrestrial system interference are those with the lowest DBS satellite EIRPs, such as the western cities near edge of coverage, for example, Seattle, San Francisco, and San Diego, and those in the Rocky Mountain States such as Colorado and Wyoming.

Current DBS satellites are about equally sensitive to terrestrial interference. EchoStar at 61.5° W.L. tested most sensitive in the DBS Oxon Hill tests, although that was due to the interference zone lying more squarely in the Northpoint transmit beam pointed at 130 degrees, compared to receivers for satellites at 101, 110, and 119 degrees. A variety of factors contribute to a DBS receiver's sensitivity to interference. These include the power and azimuth angle of the terrestrial transmitter, the proximity of the receiver to the transmitter, the arrival angle of the terrestrial beam, the orientation of the receive antenna in relation to the transmitter, and the strength of the received DBS satellite signal..

2

6. *Which DBS receivers do you think will be most vulnerable to interference and why?*
   Which DBS receivers do you recommend that we use for testing?

First generation receivers are more sensitive to interference than later generations.
Echostar models 2000 and 4000 are more susceptible than model 4700. DIRECTV has 14
approved manufacturers of receivers. DIRECTV will send two receivers from three
different manufacturers and recommends testing as many different receivers as possible.
See list of DIRECTV receivers under Question 14.

7. *Please provide information about any specifications that exist for co-channel and*
   adjacent channel protection ratios for DBS receivers.

Neither DIRECTV nor EchoStar have any specific co-channel or adjacent channel
protection ratio specifications for their equipment.

It is important to note that, in this proceeding, the impact of interference on rain
availability performance has been selected as a primary protection criterion. (*See* ¶ 213 of
the FCC's *Report and Order* in ET Docket No. 98-206). Such a criterion places limits on
the allowable increase in signal outage that is caused by a combination of rain and
interference over that caused by rain alone.

Adherence to a specific co-channel protection ratio is not appropriate for use as a
protection criterion. For digital DBS transmissions, perhaps the most direct measures of
the impact of interference are either degradation of signal availability or a complete loss
of signal. For this reason, limits on signal availability degradation and/or loss have been
chosen as the inter-service protection criteria to protect DBS systems from interfering
transmissions, whether from NGSO-FSS or terrestrial systems.

As a point of reference, an aggregate co-channel protection ratio of 28 dB was used by
the ITU as a planning parameter to set up the Region 2 BSS Plan (*see* Section 3.4, Annex
5, Appendix S30 of the ITU Radio Regulations).

8. *What are the various modes that you might operate in? What is the range of signal*
   levels, data rates, etc. that might be expected from the satellite?

DIRECTV code rates:

- 2/3 code rate: C/(N+I) = 5.0 dB; Net data rate = 23.58 Mbps

- 6/7 code rate: C/(N+I) = 7.6 dB; Net data rate = 30.32 Mbps

EIRP Variation across CONUS for 6/7 code: 57.4 dBW (Miami) to 52.2 dBW (Seattle)

EIRP Variation across CONUS for 2/3 code: 54.5 dBW (Miami) to 49.3 dBW (Seattle)

EchoStar code rate:

- 3/4 code rate: C/(N+I) = 6.1dB; Net data rate = 27.65 Mbps

EIRP Variation across CONUS: 57.6 dBW (Florida) to 48.5 dBW (Montana)

3

9. *Please provide the following documents:*

- *DIRECTV report of April 11, 1994, Terrestrial Interference in the DBS Downlink Band*
- *DIRECTV report of January 27, 2000*
- *Ex-Parte presentation of Northpoint at Exhibit C, March 17, 2000*
- *DIRECTV report, January 27, 2000*
- *DIRECTV and EchoStar ex-parte filing of July 25, 2000*

Copies of the requested documents, as well as several other important documents, have been provided.

10. *Please provide relevant hardware specifications for receive suites. Especially any:*

- *Availability of test ports*
- *Receive suite specs for minimum Eb/No reception*
- *Pass/Fail criteria, if not "no picture"*

Test Ports

There are no test ports accessible for measuring or characterizing the DBS receiver front end. The DBS operators propose the use of the DBS receiver's signal strength meter for purposes of analyzing the effects of interference into the DBS receiver. Please refer to Attachment A, "Signal Strength Indicators in DBS Receivers" for further explanation.

Receive suite specs for minimum Eb/No reception

Important information on the technical characteristics and specifications of the EchoStar and DIRECTV transmission systems can be found in ITU-R Document 6/35 (21 September 2000), a Draft New Recommendation concerning "Digital Multiprogramme Television Systems for Use by Satellites Operating in the 11/12 GHz Frequency Range". In this document, the system used by EchoStar (DVB-S) is identified as System A and the system used by DIRECTV is identified as System B. It should be noted that EchoStar uses a roll-off factor of 0.2 rather than 0.35, as stated for DVB-S. This translates to a required C/N of 6.1 dB instead of 6.8 dB.

This document (with some minor edits) was approved at the Study Group 6 level, and is expected to become a full ITU-R Recommendation. It is included as Attachment B.

Pass/Fail criteria, if not "no picture"

The DBS community uses quasi-error free operation as the "pass/fail" threshold for availability calculations. Significantly, this was also the threshold point used throughout the recent ITU-R proceedings to arrive at protection of the BSS from all interference sources, including NGSO-FSS and terrestrial sources. Operation below the quasi-error free point introduces bit errors that can significantly harm picture quality.

4

In document ITU-R 6/35, (see footnotes 1 and 2 of Table 2 of Annex 1), the quasi-error free point is identified as a maximum bit error rate of 10^{-10} for the DVB-S system and 10^{-12} for the DIRECTV system.

Table 2 of Annex 1 of ITU-R 6/35 also identifies the required C/N for the various DIRECTV and EchoStar (DVB) transmission modes:

For the two currently operational DIRECTV modes the required C/(N+I) or carrier to noise-plus-interference ratios for the quasi-error free point are as follows:

       2/3 code rate: C/(N+I) = 5.0 dB (Net data rate = 23.58 Mbps)

       6/7 code rate: C/(N+I) = 7.6 dB (Net data rate = 30.32 Mbps)
For the currently operational EchoStar mode:

       3/4 code rate: C/(N+I) = 6.1dB (Net data rate = 27.65 Mbps)

Note that these specifications are necessarily set for worst-case transponder characteristics and worst case demodulator performance. Performance through randomly selected off-the-shelf receivers and through an average satellite transponder may be better.

11. *Is an RF (or compatible IF) transmitter available that can be used in a "bench-top" environment for controlled laboratory testing?*

Unfortunately, DIRECTV and EchoStar each have only one satellite simulator, and both are currently in active use for projects with impending deadlines. It may be possible for MITRE representatives to visit a DBS operator facility to utilize one of the simulators if testing can be accomplished in a matter of days. However, DIRECTV and EchoStar strongly recommend using actual satellite signals from the DBS satellites for testing purposes, since this most closely replicates the consumer environment.

12. *Please provide details on the channelization that is used.*

The DBS channel assignment plan is available in the ITU Radio Regulations Appendix S30A, Article 10, Table 4. For ease of reference, it is provided below. Even numbered channels are LHCP, odd number channels are RHCP.

Channel No.	Assigned Frequency (MHz)	Channel No.	Assigned Frequency (MHz)
1	12224.00	17	12457.28
2	12238.58	18	12471.86
3	12253.16	19	12486.44

5

4	12267.74	20	12501.02
5	12282.32	21	12515.60
6	12296.90	22	12530.18
7	12311.48	23	12544.76
8	12326.06	24	12559.34
9	12340.64	25	12573.92
10	12355.22	26	12588.50
11	12369.80	27	12603.08
12	12384.38	28	12617.66
13	12398.96	29	12632.24
14	12413.54	30	12646.82
15	12428.12	31	12661.40
16	12442.70	32	12675.98

13. *What is your criterion for link failure? Do the links fail precipitously?*

The criterion used for "link failure" in the context of availability performance, is the quasi-error free point as discussed under Question 11. From quasi-error free performance to loss of demodulator lock is on the order of 1 dB or less for current QPSK transmissions for DBS. It should be noted that new, higher performance modulation and coding modes now in the research and development phase may exhibit even sharper transitions from quasi-error free operation to loss of demodulator lock.

14. *How will you provide equipment to us for testing? When will it be available?*

DIRECTV and Echostar will ship hardware and equipment to the address Mitre specifies. The hardware is available now and can be shipped within one business day of Mitre's request. The following items are planned to be provided for testing:

- Four DIRECTV antennas (Two 45 cm, One dual-feed, One 90 cm MDU type)
- Two Echostar 45 cm antennas
- Six DIRECTV receivers
  - RCA model DRD403RA
  - RCA model DRD460RE
  - Sony model SAT-B2
  - Sony model SAT-B3

- HNS model HJIRD-C2

- HNS model HIRD-E1

• Three Echostar receivers (models 2000, 4000, and 4700)

At a minimum, we recommend testing all three Echostar receivers, and all DIRECTV receivers listed above.

15. *What orbital positions are now in operation? What orbital slots are planned? When do you expect them to become operational?*

The current U.S. assignments extend over the following orbital slots: 61.5, 101, 110, 119, 148, 157, 166, and 175 degrees West longitude. A listing of transponder assignments can be found at http://www.skyreport.com/spectrum.htm. All of the transponders listed in the full CONUS orbital slot table on this web site are currently active. Additionally, 20 transponders are operational from 61.5°, and 16 transponders will be operational from 148° in the very near future.

In addition, there are a number of other countries that have indicated an interest in providing service to the United States. These countries and their currently assigned orbital slots include:

Canada: Assignments are at 82 and 91 degrees West longitude. (There is currently a Canadian satellite at 91° W.L. that has coverage of the continental United States, but service to the U.S. has not yet been authorized.)

Mexico: Assignments are at 69, 78, 127 and 136 degrees West longitude.

Argentina: Assignment is at 94 degrees West longitude.

Unquestionably, all current or potential orbital locations from which DBS service can be offered must be accounted for and protected.

7

Attachment A

<u>Signal Strength indicators in DBS receivers:</u>

Consumer grade receivers used for the reception of Direct Broadcast Satellite (DBS) signals employ some form of signal strength (SS) indication. The SS indication function is normally accessed by the consumer via the User Interface (UI) software associated with the installation and alignment of the home receiving equipment. The SS indication device in both DIRECTV and EchoStar consumer receivers is in the form of a bar graph meter. The meter provides a relative measure of the received signal quality. The primary intent of this indicating function is to aid in the alignment of the outdoor antenna to achieve the strongest signal possible in any particular geographic area. However, engineers for both DIRECTV and EchoStar have come to rely on these SS indicators as a valuable tool in assessing signal transmission quality and deleterious effects from rain or other interfering or noise generating phenomenon.

The utility of the SS indicator comes primarily from the fact that it is not a simple RF power indicator such as a Received Signal Strength Indicator (RSSI) from a receiver's pre-detection IF chain or Automatic Gain Control (AGC) from either the RF tuner/IF strip. This source of SS indication is common to home FM stereo receivers.

The SS indicator of a DBS receiver derives its information from the QPSK symbol demodulation and tracking loop. Internal to the demodulator, an algorithm estimates the residual noise associated with the QPSK symbols. The quantity typically reported is the Es/No, the average energy of a symbol to the average noise power in a 1 Hz bandwidth. For Gray coded QPSK, the quantities Es/No and Eb/No are mathematically related by a factor of 2. That is $Es/No = Eb/No + 3dB$. Both Es/No and Eb/No are measured in the digital domain. These quantities can be likened to the signal to noise ratio (S/N) which is the common qualitative quantity of measure for analog transmission systems. In both analog and digital systems, knowing Eb/No or S/N and channel bit rates and noise bandwidths, it is possible to determine the carrier to noise (C/N) of the RF carrier. Therefore, with simple mathematical relationships, the information from the demodulators can be used to derive Es/No, Eb/No or C/N, all very useful quantities for characterizing transmission quality and impairments to a channel.

Minor differences are encountered between IC manufacturers in the methods for calculating the bit noise ratio and hence the absolute value of the unit quantity. This is the reason why the same absolute value of a particular channel C/N may be reported as SS = 94 for one model of receiver and SS = 85 on another receiver. All that is different between the receiver models is the slope of the number of SS counts vs. decibel curve.

For example, the EchoStar Model 4000 receiver has SS meter slope of 6-7 counts/dB. This is fairly linear from below threshold; the demodulator actually remains locked below the point of the FEC lock, to very close to the end of the range of the internal IC register that holds the processed Es/No value. In the case of the Model 4000, this relates to C/N values from about 1 dB to 14 dB for the currently used channel and code rates. This

1

range is sufficient to provide accurate antenna peaking anywhere in the continental US EIRP footprints using small 18-inch antennas.

The important point to note is that any receiver can be calibrated to provide very accurate C/N or Eb/No values from the deflection of the SS meter. Once a calibration has been performed, the number of SS count difference observed under varying channel conditions can be directly related to absolute dB values of C/N degradation from the impairment. Stated another way, for a 1 dB degradation of C/N, one model receiver may report a 10 SS count delta and another model 7 SS count delta. Both SS data points are correct, accurate and repeatable knowing the associated calibration curve. Even without calibration, the change in the SS count reading from peak value to some lower value indicates the channel is suffering impairments but on a relative rather than absolute basis.

Table 1 show's a typical calibration record for an EchoStar Model 4000 receiver.

Table 1

Eb/No (dB)	SS Count	Eb/No (dB)	SS Count	Eb/No (dB)	SS Count
-1.0	20	3.8	51	8.6	81
-0.8	21	4.0	52	8.8	82
-0.6	22	4.2	53	9.0	83
-0.4	23	4.4	54	9.2	84
-0.2	24	4.6	56	9.4	85
0.0	25	4.8	57	9.6	86
0.2	26	5.0	58	9.8	87
0.4	27	5.2	60	10.0	88
0.6	28	5.4	61	10.2	89
0.8	29	5.6	63	10.4	90
1.0	31	5.8	64	10.6	91
1.2	32	6.0	65	10.8	92
1.4	33	6.2	66	11.0	93
1.6	35	6.4	68	11.2	94
1.8	37	6.6	69	11.4	95
2.0	38	6.8	71	11.6	96
2.2	39	7.0	72	11.8	96
2.4	40	7.2	73	12.0	97
2.6	42	7.4	74	12.2	97
2.8	43	7.6·	75	12.4	98
3.0	44	7.8	76	12.6	98
3.2	46	8.0	78	12.8	99
3.4	47	8.2	79	12.6	99
3.6	50	8.4	80	12.8	100

2

The accuracy and dependability of the data interpreted from the SS meter can provided valuable information to engineering and satellite operations. It provides a means to constantly monitor the condition of the satellite payload and varying regional link conditions. The information is used for statistical data collection to verify and support availability predictions and to evaluate the performance of system design improvements from the uplink transmission plant to the set-top and outdoor electronics.

DIRECTV and EchoStar believe that the use of the SS meter of a consumer DBS receiver to determine the level of link impairment from interfering sources is valid and accurate. Hence, the utility of the SS meter extends far beyond the original intent of providing an installation aid to align antennas. Through calibration, extremely accurate results can be obtained. Without calibration, there still exists a universal message from all makes and models of consumer DBS satellite receivers. That message is that clearly a reduction in signal strength counts indicates a loss of usable signal margin and consequently reduce link availability.

3